IN THE DRAWINGS

Applicants propose to amend Fig. 4 of the drawings in accordance with the accompanying ANNOTATED SHEET SHOWING CHANGES. These changes are incorporated in the accompanying REPLACEMENT SHEET.

In addition, Applicants propose to add new Figure 9 to the drawings in accordance with the accompanying added drawing sheet.

REMARKS

Enclosed herewith is a Substitute Specification in which the specification as filed has been amended to incorporate the Preliminary Amendment filed with this application, and to correct additional typographical and grammatical errors. In addition, the specification as filed has been amended to cite U.S. Patent 6,546,099 corresponding to the cited U.S. patent application. Enclosed herewith is form PTO/SB/08A citing this U.S. patent.

In support of the above, enclosed herewith is a copy of the specification as filed marked up with the above changes.

The undersigned attorney asserts that no new matter has been incorporated into the Substitute Specification.

The Examiner has objected to the drawing as not showing "the auto- and cross correlation matrices", and "the inverse of the input channel's power matrix" as specified in claims 1 and 14, and "a first order recursive network" as specified in claim 5.

With regard to "the inverse of the input channel's power matrix", Applicants submit that this feature is indeed shown in Fig. 3, and described in the specification on page 7, lines 15-20. The "auto- and cross correlation matrices" can be seen in the input channel power matrix on page 8, line 11.

The limitations of claim 5 may be found in the specification on page 10, line 7. New Figure 9 clearly shows this relationship.

In addition, Fig. 4 has been amended to correct a typographical error therein. This is shown in the specification as filed on page 7, line 6.

The claims have been amended to more clearly define the invention as disclosed in the written description. In particular, claims 5 and 7 have each been made proper independent claims and include the limitations of claim 1.

The Examiner has rejected claims 1, 6, 8, 10, 13 and 14 under 35 U.S.C. 102(b) as being anticipated by U.S. Patent 4,355,368 to Zeidler et al. The Examiner has further rejected claims 9, 11 and 12 under 35 U.S.C. 103(a) as being unpatentable over Zeidler et al. in view of U.S. Patent 6,246,760 to Makino et al.

Applicants acknowledge that the Examiner has found claims 5 and 7 allowable over the prior art of record, and in view of the above changes, claims 5 and 7 should now be allowed.

The Zeidler et al. patent discloses an adaptive correlator in which Fig. 1 therein shows a block diagram of a basic implementation of the Pairwise Magnitude-Squared Coherence algorithm. In particular, as described at col. 4, lines 32-58, input series x(k) and y(k) are transformed via FFT's 14 and 18 to successive blocks of complex Fourier coefficients. These coefficients are processed in the block 22 to form the coherence

statistic as shown in Equation (7) and shown in the block 22 in Fig. 1.

The Examiner now states:

> "...Zeidler et al discloses an adaptive filter (22) comprising at least two input signals (12, 16), and an output for supplying an output signal (24), characterized in that the adaptive filter further comprises: means for determining coefficient updates in a transformed domain (Fig. 1 shows the signals are in frequency domain after 14 and 18); an update algorithm with transformed auto- and a cross correlation matrices (Fig. 5; col. 8, lines 9-18; col. 7, lines 25-68); and means for reducing the effect of correlation between the input signals on the coefficient updates, said reducing means multiplying the frequency domain input signals (the nominator in equation 2 is formed by the frequency domain input signals) with the inverse of the input channel's power matrix (the denominator $S_X(\omega)$ in equation 2)."

Applicants submit that the Examiner is taking pieces of Zeidler et al. out of context in an attempt to show the features of the invention. In particular, the Examiner indicates that Zeidler et al. shows an adaptive filter at block 22 in Fig. 1. However, Zeidler et al. does not specifically mention block 22 in the specification, and the only place where Zeidler et al. appears to be describing block 22 is in the above-noted section relating to Equation (7) where Zeidler et al. indicates that equation (7) forms the coherence statistic. Applicants query that if the outputs of the FET's 14 and 18 are the coefficient updates for the "adaptive filter" 22, then what is the filter 22 filtering?

Further, while Zeidler et al. theoretically discusses "autocorrelation matrix" and "cross-correlation vector" at col. 7, lines 25-53, Applicants submit that there is no disclosure in Zeidler et al. of how this specifically applies in processing the coefficient updates for the adaptive filter.

In addition, claim 1 states "means for reducing the effect of correlation between the input signals on the coefficient updates, said reducing means multiplying the frequency domain input signals with the inverse of the input channel's power matrix". The Examiner indicates that this is shown in Zeidler et al. in equation (2) where the nominator is formed by the frequency domain input signals, while the denominator term ($S_x(\omega)$) is the input channel's power matrix.

Applicants submit that the Examiner is mistaken. In particular, according to Zeidler et al., at col. 4, lines 32-37, the input signal x(k) is applied to FFT 14 to generate $F_{xk}(\omega j)$ (input signal y(k) being applied to FFT 18 to generate $F_{yk}(\omega j)$), while the nominator of equation 2 is $|S_{xy}(\omega)|^2$, which Zeidler et al. defines as the cross-spectral density of x(k) and y(k). Further, Zeidler et al. defines $S_x(\omega)$ as the autospectral density of x(k) and y(k). Applicants submit, then, that contrary to the Examiner's statements, Zeidler et al. neither discloses or suggests this claim limitation.

The Makino et al. patent discloses a sub-band echo cancellation method for multi-channel audio teleconference and echo canceller using the same, in which Makino et al. splits the signal into sub-bands, down-samples these sub-bands, and treats the sub-band signals as "normal" time signals. That is, for each sub-band, an adaptive filter is applied that consists of an FIR filter with multiple taps. Instead of using a standard LMS algorithm, Makino et al. uses an ESP algorithm (see col. 2, line 34), which is only useful for a multiple tap algorithm or, in general, for time domain signals. To reduce the effect of correlation in the input signal, the VARIATION component of the cross-correlation is emphasized (col. 11, lines 34-37 and 43-55) by using the sample decimation and/or the ESP algorithm.

The subject invention also relates to acoustic echo and noise cancellation and attempts to solve the same problems as Makino et al. However, the approach of the subject invention is different from that of Makino et al. In particular, in the subject invention, all signals are transformed to the frequency domain using, for example, FFTs, and all operations are performed in the frequency domain. To reduce the effect of cross-correlation, the frequency domain input signals are multiplied with the inverse of the input channel's power matrix, consisting of auto-power and cross-power spectra terms.

The subject invention does not user variation of the cross-correlation components. In fact, the subject invention is effective in situations where the cross-correlation does not change. Furthermore, the subject invention works for what is called a "block frequency domain" approach, where, for each frequency component, the value of the transfer function to be modeled consists of only one complex component and for a partitioned block frequency domain adaptive filter where the transfer function consists of a (preferably) small number of complex values.

There is a clear distinction between block convolution based frequency domain adaptive filters, as in the subject invention, and sub-band adaptive filters as used in Makino et al. An overview is given in "Frequency-Domain and Miltirate Adaptive Filtering" by J.J. Shynk, IEEE SP Magazine, January 1992, pp. 15-37.

Applicants therefore submit that the main difference between Makino et al. and the subject invention is that Makino et al. uses a time variation component of the cross correlation, while the subject invention uses the inverse of the power matrix.

Applicants therefore submit that Makino et al. does not supply that which is missing from Zeidler et al., i.e., among others, "means for reducing the effect of correlation between the input signals on the coefficient updates, said reducing means

multiplying the frequency domain input signals with the inverse of the input channel's power matrix".

In view of the above, Applicants believe that the subject invention, as claimed, is neither anticipated nor rendered obvious by the prior art, either individually or collectively, and as such, is patentable thereover.

Applicant believes that this application, containing claims 1 and 5-14, is now in condition for allowance and such action is respectfully requested.

Respectfully submitted,

by
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On 10/18/2005
By Burnett James

ANNOTATED SHEET SHOWING CHANGES

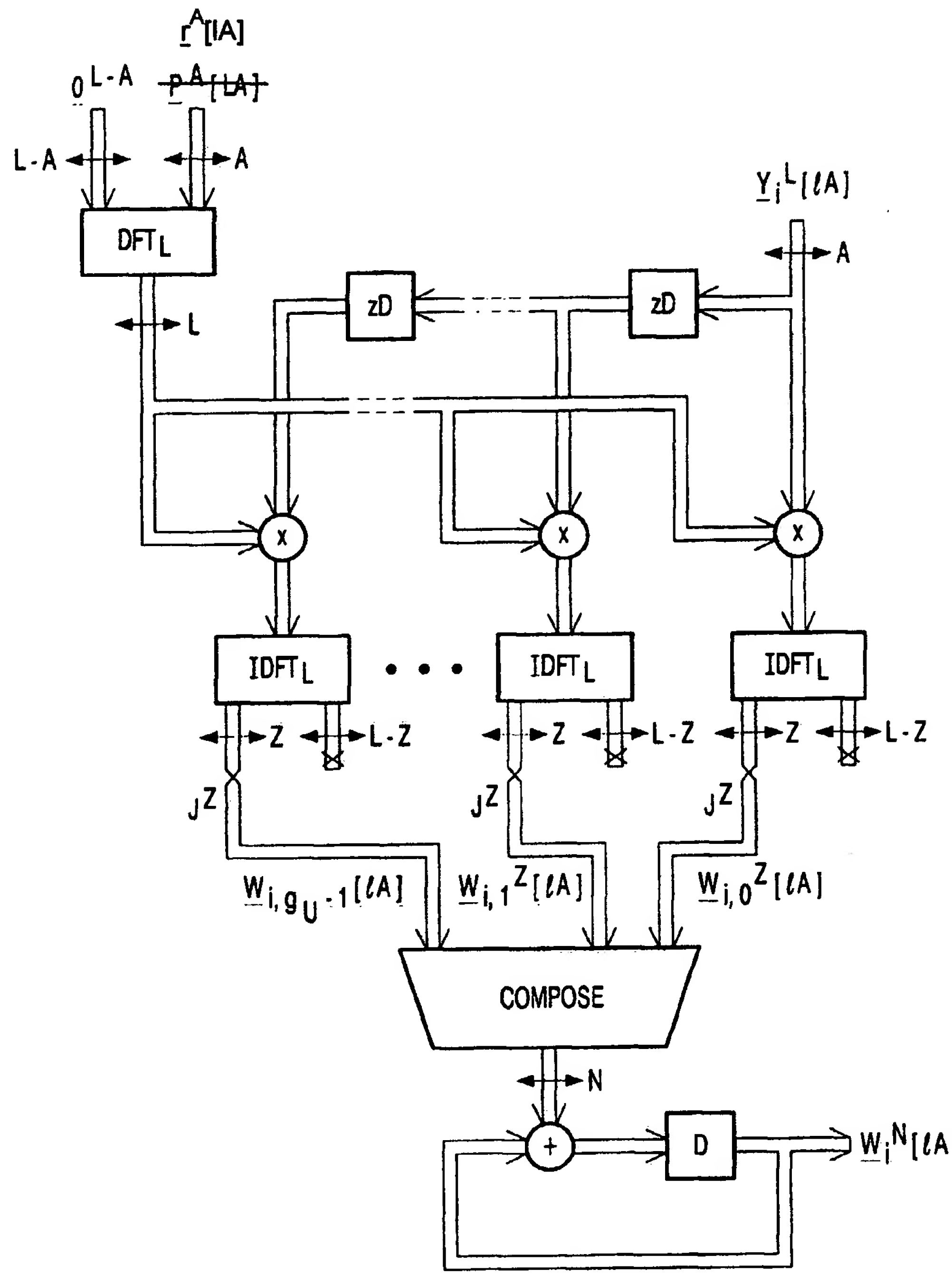

FIG. 4